Hydrogeology and Ground-Water Flow Simulation of a Karst Ground-Water Basin in the Valley and Ridge Physiographic Province near Hixson, Tennessee

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Cave Springs is one of the larger springs in Tennessee, one of the most heavily stressed, and an important source of water for Hixson, Tennessee. Cave Springs derives its flow from a carbonate rock (karst) aquifer in the Valley and Ridge Physiographic Province. The aquifer framework in the Cave Springs area consists of dense Paleozoic carbonate rocks with secondary permeability mantled by thick residual clay-rich regolith in most of the area and coarse alluvium in the valley of North Chickamauga Creek. Transmissivities estimated from well hydraulic tests conducted across the Cave Springs area span a wide range, varying from 240 to 900,000 foot squared per day (ft^2/d) with a medium value of 5,200 ft^2/d. Recharge to the aquifer occurs both from direct infiltration of precipitation and from losing streams. Most recharge occurs during the winter and spring months.

Current ground-water withdrawals from the Cave Springs area by the Hixson Utility District average about 8 million gallons per day (Mgal/d) from two well fields, Cave Springs (6 Mgal/d) and Walkers Corner (1.7 Mgal/d). Present and planned future withdrawals may be approaching the capacity of the ground-water system to supply the utility district needs. The U.S.Geological Survey, in cooperation with the Hixson Utility District, conducted a study integrating previously collected information about the Cave Springs area ground-water system to evaluate both the annual water budget and the effects of current and planned increases in ground-water withdrawals.

To address these questions, a numerical ground-water flow model of the ground-water system was constructed and calibrated using MODFLOW 2000. Preliminary results of the modeling effort indicate that losing streams along the base of Cumberland Plateau escarpment at the western edge of the study area are an important source of recharge to the ground-water system, supplying about 50 percent of the recharge to the study area. The other source of recharge, direct infiltration of precipitation, accounts for the remaining recharge to the study area. Current ground-water withdrawals (7.7 Mgal/d) equal about 14 percent of the total ground-water recharge with the remaining 86 percent discharging to rivers (46 percent), springs (18 percent), and Chickamauga Lake (22 percent). Current drawdown at the Walkers Corner well field is about 33 feet at the center of a cone of depression that is elongated along strike. If additional pumping at Walkers Corner increases total withdrawals to 9.7 Mgal/d, simulated drawdown at Walkers Corner well field increases to about 60 feet. The additional ground-water withdrawals result in a 5-percent decrease in discharge to Chickamauga Lake, a 4-percent decrease in discharge to rivers, and a 2-percent decrease in discharge to springs.

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